THE TECHNIQUE OF THE POSITIVE AND NEGATIVE DIAGNOSIS OF URETERAL AND RENAL CALCULI BY THE AID OF THE RÖNTGEN RAYS.

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Any impairment of function in the kidney affects the whole system, and, although one kidney can perform the work of both, the partial or complete loss of one kidney affects the health, and renders the patient liable to the sudden perils of complete anuria. An early, accurate diagnosis is thus of the greatest importance, and yet the incompleteness of the symptom complex frequently makes a differential diagnosis impossible. The Röntgen-ray method, by detecting or absolutely excluding calculus, has rendered a great service. In all cases where a suspicion points to calculus, it can be confirmed or absolutely disproved.

Some time ago (*Philadelphia Medical Journal*, August 20, 1898) the author demonstrated the possibility of absolute accuracy in both the negative and positive diagnosis, and later (*Philadelphia Medical Journal*, April 11, 1899) showed the clinical value and necessity of such an accurate method.

This method was proved to have the following advantages: Mathematical accuracy, positiveness, and comprehensiveness. The early period at which the diagnosis is made, and the consequent early operation, decreases the mortality and prevents partial destruction of the kidney. It avoids the dangers and pain attendant upon exploratory operations and gives a more definite diagnosis. The detail secured facilitates operation and insures its completeness. The examination of both kidneys and ureters localizes the operative interference, prevents operation on the wrong kidney, or unwitting operation on either, when both are the seat of calculous disease. Impacted or quiescent calculi in the pelvis of the kidney, its calices, or in the ureter, are detected, if only suspected. The absolute negative diagnosis renders rational a non-operative treatment, that would otherwise often endanger the life of the patient. It is especially in cases of anuria, either partial or complete, that the exact localization of the impacted calculus is of the utmost importance. If it remains, in partial anuria, the function of the affected kidney is destroyed, and so insidiously that it is impossible to distinguish destruction from recovery. Complete anuria is readily recognized, but the exact localization of the calculus and its immediate removal are essential to recovery.

The careful examination of the ureters as well as the kidneys is thus an essential of every complete Röntgen-ray diagnosis. The negative as well as the positive diagnosis can only be made by an operator who possesses a technique that permits him to show in the lumbar and pelvic regions shadows of tissues less dense than the least opaque calculus. One perfect negative, having this amount of detail, is sufficient for an absolute negative diagnosis. In order to eliminate defects in the emulsion on the plate, or those produced in developing, two or more plates showing the calculus in the same position are essential to the positive diagnosis.

The negatives are not always dense or easily read, as density is in some cases incompatible with the necessary detail. Experience and a skilled eye are needed in reading them as much as a technique in making them. This is the only source of error that involves the personal equation of the operator, *i.e.*, his ability to read correctly what the negative shows. All negatives should be studied with care under varying conditions, and should always be dry before a negative diagnosis is given, as the slight differential shadows can escape detection while the plate is wet. Duplicate negatives should be made upon the same day, if there is any chance of the calculus moving; although later exposures showing the calculus in the same position prove that it is quiescent or impacted. As in all instances, of the localization of foreign bodies, operation should follow as soon as practicable, while all motion should be avoided in the interval.

The difficulties and errors that may present themselves if these precautions are not observed are illustrated by the following cases:

The examination of Mr. C. gave a negative diagnosis for the kidneys. The only pelvic picture taken appeared to show a calculus in the right ureter just outside the bladder. The negative was, however, defective, and a positive diagnosis could not be established by it, as, unfortunately, no duplicate had been made. Before the patient could come for a re-examination he had an attack of renal colic, and, as the subsequent plate failed to confirm the first, a negative diagnosis was rendered. He afterwards passed a calculus weighing nine-tenths of a grain, which conformed to the shadow in the first skiagraph. It undoubtedly passed into the prostatic urethra during the attack of colic, as a skilled surgeon failed to detect it, although the bladder was washed out with a Bigelow's evacuator. Had a duplicate skiagraph been made at first, it would have undoubtedly confirmed the diagnosis.

The case of Dr. F., of Chicago, also illustrates the value of examining the ureters. He was not satisfied with an X-ray examination which had been made of his kidneys, as his symptoms were acute and typical of calculous disease. He wrote, stating the circumstances and asking an opinion. As the sample of urine received showed crystals of oxalate of lime, besides other evidences pointing to calculus, it was probable that a calculus, if present, would be of that variety. Such a calculus would have been readily detected by any method, but the ureters had not been examined. The probability of a quiescent calculus in the ureter was suggested, and he decided to come on for examination. Before he could complete his arrangements for the trip, he passed a small cylindrical calculus, one-half inch in length, with symptoms that localized it in the lower ureter.

In the case of Mr. M., a series of negatives taken in duplicate, extending over six months, showed a minute calculus in the ureter just outside the bladder. It was undoubtedly impacted, but the age and condition of the patient precluded operation. In one of the earlier plates the calculus had been present, but had not been detected, showing that the method was correct, but that its interpretation was inaccurate.

Another source of error is illustrated by the case of Mr. K. The negative had all the requisite differentiation in the pelvic and lumbar regions, but failed to cover the left kidney, extending only to the top of the third lumbar vertebra. The shadow of the kidney and calculus were thus cast above the plate. This error in diagnosis was due to faulty technique, the result of decreasing the number of exposures by an attempt to cover the entire region with one plate. It can be avoided by care in placing the plate.

In the case of Mr. N., a large and small calculus were found in the pelvis. It was found impossible to crush the larger calculus, which was removed through a perineal incision. The smaller one could not be found, though a finger was passed into the rectum and another into the bladder. Subsequent skiagraphs showed that the calculus was still there. Later experience leads me to believe it was in the ureter.

Mr. E. Stanmore Bishop (*Edinburgh Medical Journal*, July, 1899) has reported three successful operations upon ureteral calculi impacted in the lower ureter. In one case a large vesical calculus was removed, and later, during a delayed recovery, the ureteral calculus was detected and removed. The Röntgen rays had not been employed.

In cases where calculi are found by the Röntgen examination in the ureter, the presence of complete or partial obstruction can be determined by watching the urinary flow from that ureter with the cystoscope, and assists in forming a rational basis for treatment.

Bishop (*loc. cit.*) suggests suprapubic cystotomy as a direct extra-peritoneal route for attacking and removing these calculi, as the ureters low down, where the calculi frequently lodge, can be readily reached through the bladder wall. Where the cystoscope shows that the calculus projects into the bladder sufficiently, it can be grasped with the lithotrite, drawn out and crushed, an operation which has already been accomplished.

The following is the routine technique which has been developed and employed in the study of the appended series of cases, which include only those examined since the negative, as well as positive diagnosis has been possible. All clothing containing opaque foreign bodies is removed from the area to be examined, and, if the breathing is markedly diaphragmatic in type when in the recumbent position, a binder is applied. The plate, protected from moisture and heat, is placed beneath the patient supported by a heavy board. The latest practice has been to employ a plate that extends from the last dorsal vertebra to below the pubic arch and sufficiently wide to cover both lumbar regions. Both kidneys and ureters are thus examined at the same time. The tube is placed in the median line above the third lumbar vertebra, and at such a height that its rays pass through the pelvis and cast a symmetrical shadow of the pelvic outlet on the plate below. A grounded screen of sheet aluminum or gold leaf on cardboard is always interposed between the tube and patient.

Skiagraphs are shadows, the varying densities of which correspond to structures each of which has a relatively constant resistance to the penetration of the Röntgen discharge. The more opaque shadows represent substances that absorb or disperse the most rays, the less opaque permit more rays to pass, while complete penetration is represented by complete absence of shadow.

Although all substances maintain constantly their relative opacity, this relative opacity varies in its shadow representation with the shortness or length of the exposure, and with varying qualities of Röntgen discharge, that in turn depend upon the varying state of the vacuum in the tube and on other physical phenomena present in their production.

The greatest value of the Röntgen ray in physical diagnosis is not in penetrating all tissues, but in producing differentiations between tissues that will lead to logical conclusions and absolute diagnosis. Thus, in examining for calculi, we do not want rays that will penetrate all tissues; we want a differentiation in the shadows that will demonstrate beyond a doubt that all calculi, no matter what their relative density, would cast shadows if present in the field examined. Such definition and differentiation make the negative diagnosis absolute. The object, therefore, when examining for renal calculi by this method of diagnosis, is to obtain negatives in which the shadows are shown of tissues less opaque than the least opaque calculus. Where such definition is obtained, it is certain that not even the smallest calculus can escape detection, no matter what its composition is.

Experience has demonstrated the fact that tissue differentiation can be obtained by employing a Röntgen discharge from a tube having a low vacuum. The vacuum which is most suitable for these examinations is equivalent in resistance to one or one and a half inches of spark in air, as measured by the parallel spark gap on the coil. The wattage, or volume and voltage, of the secondary spark employed in overcoming this resistance has a direct bearing upon the volume of Röntgen discharge produced from the tube. The wattage of the secondary circuit must be high and the amount of discharge great, if rapid exposures are to be made. Such high efficiency is not required in the secondary circuit when higher vacua are employed, but then the penetration is too great, and all tissue differentiation is lost. The efficiency of an induction coil does not depend on the length of the spark, but upon the number of watts produced in the secondary circuit. It is this deficiency in wattage or in the amperage of a short spark that renders the static machine so inefficient where low vacuum tubes should be employed.

The self-regulating tube makes it easy to obtain and maintain the required vacuum that produces a Röntgen discharge which will differentiate between the softer tissues in the lumbar and pelvic regions. The vacuum employed is equivalent in resistance to a one and one-half or a two inch spark in air, as measured on the parallel spark gap on the coil. The secondary discharge of the coil must have a heavy wattage, a fat spark being an essential in producing a sufficient volume of low vacuum discharge to penetrate the lumbar or pelvic regions. Where such definition is obtained that tissues less dense than the least dense calculus are shown, evidently no calculus can escape detection. The length of the exposure depends entirely upon the efficiency of the coil in producing a heavy Röntgen discharge from a low vacuum tube. In these cases it has been varied from five to fifteen minutes, with the individual resistance of the patient. The negatives are seldom dense, except in favorable subjects. They require study, and experience in other X-ray work is essential; but to the experienced eye each perfect negative furnishes absolute proof of the presence or absence of all calculi. A proof produced mechanically and free from the personal equation.

The appended series of cases upon which this paper is based have all been examined since the absoluteness of the negative, as well as the positive, diagnosis was established.

Fifty-nine cases here have been referred for examination in which the symptoms were either so marked as to simply need confirmation and the additional detail regarding numbers or position of the calculi, or where a differentiation from other conditions could not be made in any other way; or again, where a negative diagnosis needed confirmation. Under all these circumstances diagnosis has been found valuable and correct, while in some cases a positive diagnosis has been established where a negative was expected, or multiple calculi found where one was supposed to be present.

Calculi, single and multiple, were found in eight cases that were confirmed by operation. In one other case a small ureteral calculus was passed, and two other ureteral calculi were shown to be present by subsequent skiagraphs, where the age and condition of the patient did not permit operation. In one case the patient refused operation and left the hospital. In all of the seven cases of negative diagnosis subsequently operated on by nephrotomy, nephrectomy, or nephrorrhaphy the correctness of the diagnosis was confirmed with the exception of one case, already mentioned, where the error was due to faulty technique. Of the 59 cases examined, twelve were found to be the subjects of calculous disease.

There follows a chronological summary of the cases examined, with a brief *résumé* of their interesting features.

CASE I.—March 15, 1898. Mr. C. S. W., referred by Dr. Edward Martin. His symptoms were sufficiently pronounced to lead to a diagnosis of calculus. This diagnosis was confirmed by the skiagraph (Fig. 1), with the additional detail that two calculi were present, and giving their position. This facilitated their removal, as the smaller calculus was encysted, and was only found by measurements derived from the skiagraph. They were uric acid calculi, weighing thirty-two grains and ten grains.

CASE II.—March 22, 1898. Mr. P., referred by Dr. James Tyson. The symptoms of lumbar pain and the persistence of albumen in the urine, together with other symptoms, lead to a suspicion of calculus. The skiagraph, however, showed the absence of calculi.

CASE III.—March 22, 1898. Miss G., referred by Dr. Edward Martin. She had some blood and albumen in the urine, which could be accounted for by the movable kidney. The subsequent nephrorrhaphy confirmed, so far as palpation and needling could, the negative diagnosis furnished by the skiagraph, while the operation relieved the patient of all symptoms.

CASE IV.—April 5, 1898. Mr. C. S., referred by Dr. J. William White. The patient had pain in the lumbar region, shooting down into the groin. He had never passed calculi. The urine showed blood, pus, and albumen. The negative diagnosis was confirmed by a subsequent nephrotomy, which disclosed a tubercular kidney.

CASE V.—April 18, 1898. Mrs. S., referred by Dr. J. William White. She had a renal tumor with urinary symptoms that suggested the presence of a calculus. None, however, was found by the skiagraphic examination.

CASE VI.—May 17, 1898. Mr. H. A. L., referred by Dr. J. William White. Had had attacks of renal colic at frequent intervals, and had passed previously a small mulberry calculus. Two months ago the passage of gravel ceased, and the paroxysms of pain increased in frequency and intensity. Urine was acid; sp. gr. 1032. No blood, no pus, heavy deposits of uric acid gravel. The skiagraph showed the presence of a calculus, which was found encysted in the superior calyx and was covered with urates. It weighed twenty-one grains.

CASE VII.—May 23, 1898. Mrs. D. Dr. C. L. Leonard. In this patient the presence of a movable kidney was readily detected. The kidney was tender, and, as calculi are sometimes present in these kidneys, examination was advised. No calculus was found.

CASE VIII.—Mrs. A. K. D., referred by Dr. J. William White. In this patient calculi were present in both kidneys. The right kidney was operated upon and the calculus removed. The patient recovered from the operation, but the kidney was too nearly disorganized to maintain its function. The post-mortem examination showed the skiagraphic diagnosis to be correct, and that the three calculi in the left kidney had destroyed it totally, although no symptoms had ever been referred to that side or that kidney. The calculus removed weighed four drachms, ten grains.

Case IX.—November 3, 1898. Mr. P., referred by Dr. J. William White. The patient had for some time had marked hæmaturia, with an increase on motion and symptoms that simulated in a degree calculus. The skiagraphic examination showed us calculus to be present.

Case X.—November 3, 1898. Mr. S. S., referred by Dr. Edward Martin. Though having symptoms that suggested calculus, the skiagraph confirmed the previous negative diagnosis.

Case XI.—November 19, 1898. Mr. C. S , referred by Drs. Mitchell and Martin. This patient had had marked but indefinite symptoms of renal calculus, extending over a period of twelve years. Although examined on numerous occasions by prominent surgeons, the diagnosis had never been established, while exploratory nephrotomy had only been once suggested. The symptoms at this time were more marked, but were still indefinite. The skiagraphs showed a large hydronephrotic kidney, with one large and two small calculi. Every detail was subsequently confirmed by the operation. The kidney was sacculated and enlarged, and the three calculi were removed. The patient recovered completely. In this case, as in others where multiple calculi were shown, the value of such detail was demonstrated in making the operation complete.

Case XII.—November 29, 1898. Mr. J. H., referred by Dr. James Tyson. He has had indefinite lumbar pain for six years; has had slight traces of blood in urine, but had never passed a calculus. The only symptoms were lumbar pain, a trace of pus, and some albumen. The skiagraphs showed a small calculus. Dr. White performed an exploratory nephrotomy, but was unable to palpate the calculus or touch it with a needle in the apparently healthy kidney. The incision into the kidney disclosed the correctness of the diagnosis, as an oxalate calculus was removed that weighed twelve grains.

Case XIII.—December 1, 1898. Mrs. C., referred by Dr. Sharp. She had an indefinite pain in the lumbar region that had recurred in crises at various intervals, and had some of the characteristics of nephritic colic, when taken in conjunction with the pus and albumen in the urine. The suspicion was not confirmed by the skiagraph, as no calculus was found.

Case XIV.—December 2, 1898. Mr. Charles B., referred by Dr

J. William White. This patient was sent for the confirmation of a negative diagnosis, as his symptoms were sufficiently obscure to make it seem necessary. No calculus was found.

CASE XV.—December 3, 1898. Mr. W., referred by Dr. Edmund W. Holmes. He had several attacks of pain simulating renal colic, with the presence of hæmorrhage, but no pus or casts. No calculus was found to be present.

CASE XVI.—December 6, 1868. Mr. G. F., referred by Dr. Edward Martin. This patient had but a slight amount of pain with no crises. There was a slight amount of pus and albumen. The negative diagnosis was confirmed by the skiagraph.

CASE XVII.—December 6, 1898. Mr. W. W., referred by Dr. J. William White. He had had frequent attacks of acute pain in the lumbar region, but not characteristic of renal colic. Just before the examination he had had pain with chill and sweating, with a lingering pain through back and limbs. The urine was normal in odor and color, no albumen, no sugar, acid in reaction, the microscope showed a few pus-cells, occasional red cells, some epithelium, but no casts. The skiagraph showed the presence of a calculus, which was removed by operation and weighed seventeen grains. It was composed of phosphates and oxalates.

CASE XVIII.—December 15, 1898. H. S., referred by Dr. J. William White. He had had repeated attacks of colic of moderate degree. There was blood and pus in the urine, but the attacks were far apart. The skiagraph showed the presence of a calculus, but this was not confirmed, as the patient refused operation.

CASE XIX.—January 20, 1899. Mrs. M. L., referred by Dr. G. E. Shoemaker. This patient had symptoms that suggested calculus, with recurring attacks of lumbar pain, though no true colic, followed by increased amounts of pus in the urine. The skiagraph showed the absence of calculi.

CASE XX.—January 24, 1899. Mr. S., referred by Dr. H. C. Wood. The symptoms in the case were indefinite, though simulating calculous nephritis. There was marked oxaluria and slight albuminuria, but no hæmaturia or pus. The skiagraphic diagnosis was negative. The symptoms were entirely relieved by subsequent medical treatment.

CASE XXI.—January 26, 1899. Miss P., referred by Dr. S. W. Morton. This young lady was anæmic, and had suffered for a considerable time from lumbar pain, which, however, was not characteristic, though the symptoms were in general such that a negative

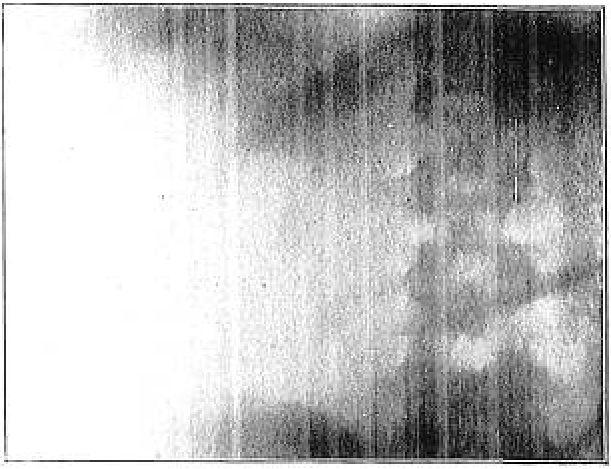

FIG. 1.—Dr. Edward Martin's case of renal calculi.

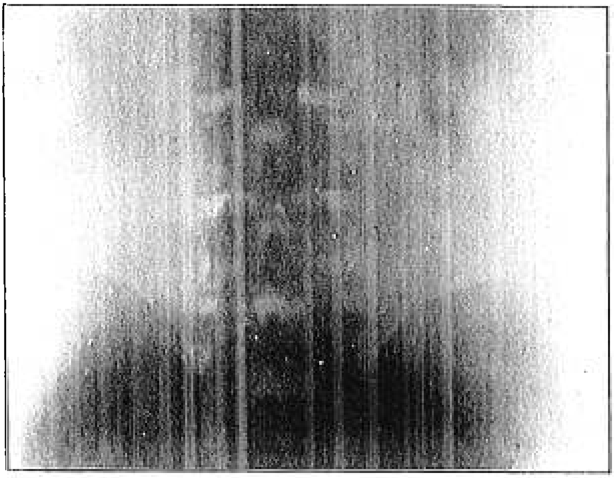

FIG. 2.—Dr. W. W. Keen's case of renal calculus.

diagnosis needed confirmation. This confirmation was secured by the skiagraphic examination.[1]

CASE XXII.—February 19, 1899. W. A. D., referred by Dr. James Tyson. This patient had had a series of acute attacks that seemed to point to a calculus in the right ureter, where a distinct point of tenderness was found. The urine also pointed to the possibility of calculus, but the case had to be differentiated from appendicitis of a mild type. The skiagraph showed that calculi could be excluded.

CASE XXIII.—Maich 6, 1899. Mr. W. M., referred by Dr. J. William White. The symptoms in this case pointed to chronic cystitis. The absence of calculous disease was proved by the skiagraph.

CASE XXIV.—March 7, 1899. Mr. A. D. C., referred by Dr. W. W. Keen. The patient's symptoms were sufficiently typical to make the diagnosis of calculous disease probable. The skiagraphs made it positive (Fig. 2). The oxalic acid calculus was subsequently removed and weighed forty-eight grains.

CASE XXV.—April 5, 1899. Dr. T. E. P. He had had during the previous six or eight years a succession of attacks of nephralgic pain, which, however, were atypical and had never been very severe. The pain had finally become nearly constant, of a dull character, with acute exacerbations. No calculi could be found and the negative diagnosis was established.

CASE XXVI.—April 6, 1899. Mr. M., referred by Dr. J. William White. He had a persistent cystitis, with symptoms that made calculous nephritis a possibility. This made the absolute negative diagnosis afforded by the skiagraph essential.

CASE XXVII.—April 15, 1899. Miss S., referred by Dr. A. J. Downes. The patient had a slight hæmaturia, with a trace of pus. A cystoscopic examination and divided urines showed the trouble to be unilateral, and possibly tubercular, though this could not be confirmed by the bacteriological test. The skiagraph showed the absence of calculi. A subsequent nephrectomy confirmed the negative diagnosis.

CASE XXVIII.—April 24, 1899. Mrs. T. L., referred by Dr. H. L. Williams. She had had pain in the left lumbar region for many years, with acute attacks that were so severe as to cause the birth of her last child at the seventh month. At first the pain recurred once in two months, but for the past year had been more frequent, while there had been a constant dull pain in that region. The urine, however, did not confirm a diagnosis of calculus, while the skiagraph showed no calculi to be present.

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[1] This case was subsequently operated upon by Dr. John K. Deaver. A valvular condition was present in the ureter, producing a hydronephrosis. The pelvis of the kidney was opened, but no calculus was present. This negative diagnosis is the seventh confirmed by operation.

CASE XXIX.—April 25, 1899. Mr. I. P., referred by Dr. J. William White. This patient had suffered for twenty months with lumbar pain, and had had crises that simulated renal colic. The urine showed microscopic quantities of blood. The skiagraph showed the absence of all calculi.

CASE XXX.—April 25, 1899. Mrs. B., referred by Dr. J. Bryan. She had had frequent attacks of pain in the right lumbar region. The kidney was slightly movable, but the urine showed no indication of calculus. The skiagraph gave a negative diagnosis, which was confirmed at a subsequent nephrorrhaphy by palpation and needling. The operation relieved her of all symptoms.

CASE XXXI.—April 26, 1899. Mr. G., referred by Dr. S. S. Cohen. The examination confirmed a previous negative diagnosis, though the patient's symptoms suggested the possibility of calculous disease.

CASE XXXII.—April 27, 1899. Dr. H. H. S. Seventeen months previously he had had an attack with suppression of the urine. He had never passed crystals or calculi, nor had he had actual attacks of renal colic. He had pricking sensations on jarring, as by a false step. The pain is a dull ache, sometimes severe, especially before a storm. Albumen was present in the urine, but no blood or pus. The diagnosis was negative.

CASE XXXIII.—April 28, 1899. Mr. D. R. H., referred by Dr. J. William White. Twelve years previously had had attacks that were called renal colic, radiating down into the groin and lasting for three or four hours, and only relieved by morphia. Of late, these attacks have been less severe, but he has a dull ache in the old spot. Marked cystitis is present. The negative diagnosis was confirmed by the skiagraph.

CASE XXXIV.—April 28, 1899. Mr. K., referred by Dr. Steinbach. The patient had indefinite symptoms that suggested calculus. The skiagraph, however, demonstrated their absence.

CASE XXXV.—May 3, 1899. Mr. A. B. D., referred by Dr. Samuel Holman, of Pittsburg. This patient had persistent lumbar pain, which became very severe at times, though there was no actual renal colic. The severity of the pain would be suddenly relieved, and a copious discharge of pus would be found in the urine, which then gradually diminished till renewed after another attack. The urine showed pus, some red blood-corpuscles, a slight amount of albumen, no casts, and occasional oxalate crystals. No tubercle bacilli had been found on repeated tests. Calculous disease was excluded by the skiagraphic examination.

CASE XXXVI.—May 4, 1899. Mrs. T., referred by Dr. J. William White. The symptoms which simulated calculous disease were shown by the examination to be dependent on other causes, probably the result of the cystitis, which was marked.

CASE XXXVII.—May 10, 1899. Miss E. A. F., referred by Dr. H. B. Allyn. She had suffered from lumbar pain of an indefinite character, with crises that simulated renal colic, but were not intense. The urinary symptoms did not confirm the diagnosis of renal calculus, and the skiagraph gave a negative result.

CASE XXXVIII.—May 14, 1899. Mrs. C. S. F., referred by Dr. C. Foltz. This patient presented many symptoms that simulated calculous nephritis, but they were not sufficient to establish a diagnosis. The cystoscope showed the orifice of the left ureter to be inflamed. There had been a previous cystitis that yielded to treatment in a measure, but pain persisted on micturition. Although the bacteriological tests were not positive, it seemed probable that the case was one of tubercular type, as no calculi were present. The subsequent development of the case showed it to be of tubercular character.

CASE XXXIX.—May 23, 1899. Miss G., referred by Dr. B. C. Hirst. She had had lumbar pain that simulated calculous disease in type, but was not so severe. The urinary analysis showed pus and albumen, but there was no other evidence that would suggest calculus. The examination showed that no calculus was present.

CASE XL.—May 23, 1899. Mrs. M., referred by Dr. Edward Martin. Although the symptoms were not typical of stone in this case, they were sufficiently suggestive to make the negative diagnosis obtained from the skiagraph very valuable.

CASE XLI.—May 23, 1899. Mrs. W., referred by Dr. D. B. Birney. The urinary analysis in this case, combined with the persistent symptoms of localized pain and tenderness in the right lumbar region, made the exclusion of calculus necessary. The skiagraph showed the absolute absence of calculi in that region.

CASE XLII.—May 26, 1899. Dr. H. A. W. The symptoms which brought this patient for examination had existed for some years, but, although they seemed to indicate the presence of a calculus, they had never been sufficiently characteristic to permit any of the surgeons consulted to advise operation. The examination demonstrated the absence of calculi in the kindey. This diagnosis was confirmed by a Röntgen-ray examination made by an expert in London some weeks later.

CASE XLIII.—May 29, 1899. Mrs. D., referred by Dr. H. A. Beyea. The negative diagnosis was confirmed by the skiagraphic examination, although the symptoms were sufficiently characteristic to make the exclusion of calculus necessary and valuable.

CASE XLIV.—May 29, 1899. S. T. S., referred by Dr. J. William White. This patient had indefinite symptoms that were chiefly those of chronic cystitis. There was, however, considerable lumbar pain, which made calculous disease of the kidney possible. The examination of the kidneys showed them to be free from calculi, but a small, partially encysted calculus was found in the bladder and removed.

CASE XLV.—May 30, 1899. Mr. J. C., referred by Dr. J. H. Lloyd. This patient had had frequent attacks of renal pain that simulated colic. There was no pus in the urine, but blood in varying quantities with uric acid. As previously mentioned, the first examination showed the kidneys to be free from calculi, while the right ureter presented the indefinite shadow of a small calculus. The second plate of the pelvis, made after an intervening attack of colic, failed to show a calculus at that point, and a negative diagnosis was rendered. The patient subsequently passed, *per urethram*, a uric acid calculus weighing nine-tenths of a grain. It corresponded in bulk with the shadow in the first pelvic negative, and had probably been passed during the subsequent colic, and had thus escaped detection and the confirmation that made a positive diagnosis. It undoubtedly was not present in the ureter when the negative diagnosis was made.

CASE XLVI.—June 13, 1899. Mr. N. C. M., referred by Dr. Mitchell. He had had for some time a slight disturbance and some pain, but no true renal colic, on the right side. An examination some months previously had shown that the kidneys were free from calculi. A re-examination confirmed this negative diagnosis, but a further examination showed a small calculus in the right ureter just outside the bladder. Multiple skiagraphs demonstrated the accuracy of the observation and showed its position to be as stated above. A subsequent examination on October 27 showed that it had maintained its position. In the negative the outline of the bladder can be clearly made out, and the calculus is just outside of it.

CASE XLVII.—September 21, 1899. E. S., referred by Dr. Edward Martin. This patient had passed four calculi. The last was eighteen months previous to the examination. During the previous attack he had had lancinating pain. The urine had been dark, but no blood had been passed. Large quantities of uric acid crystals were always present. There has been an intermittent pain in the right kidney for some time past, but no true colic. The examination of the kidneys and pelvis yielded a negative diagnosis. Some uric acid gravel was subsequently passed.

CASE XLVIII.—October 3, 1899. G. L., referred by Dr. J. William White. This patient had had several severe attacks that were not typical in character, but pointed to either biliary or renal lithiasis. The urinary analysis showed nothing that would indicate the presence of a renal calculus, and the skiagraph confirmed a negative diagnosis.

CASE XLIX.—October 9, 1899. G. B. W., referred by Dr. Edward Martin. Persistent lumbar pain, which had existed for years, together with indefinite symptoms of renal disease, led to an examination of the kidneys, although the marked cystitis present sufficiently accounted for the present condition. The skiagraph excluded calculus.

CASE L.—October 12, 1899. H. S. H., referred by Dr. J. M. Barton. This patient had had recurring attacks of colic for four or five years, and had passed calculi on two occasions, the last having been passed in August. There were present in the urine a trace of pus, albumen, and a few red corpuscles, with oxalic and uric acid crystals. The pain was not severe, nor were there characteristic crises of colic. There were no calculi present.

CASE LI.—October 13, 1899. C. S., referred by Dr. D. D. Stewart. The patient had suffered from lumbar pain for some time past. He had, however, no typical attacks of colic, nor had he ever passed calculi. The urinary analysis was such that calculus was strongly suggested. Microscopic quantities of blood and pus were present. The skiagraph showed that no calculi were present. The symptoms were, however, sufficient to justify operation. Dr. W. W. Keen explored the kidney on January 18, but found no calculus. There were numerous adhesions.

CASE LII.—October 24, 1899. B. F. W., referred by Dr. D. M. McMasters. Eighteen months ago this patient had intense pain that was like renal colic, but yielded rapidly to a small hypodermic of morphine. Calculi have never been passed, and the urine has always been normal in character. Slight jaundice was noted after the earlier attacks, where the pain was located on the right side. It has been absent in the later ones, which were less intense and intermittent, and in which the pain was indefinitely located in the left lumbar region. The last attack had persisted with varying intensity for the past ten days, and was always worse in the daytime. The examination showed the shadows of the kidneys, but no calculus was found in them or in the ureters.

CASE LIII.—October 24, 1899. J. J. M., referred by Dr. A. J. Downes. This patient had passed calculi on three occasions. The last was passed five years ago, since which time he had been free from symptoms until nine months ago, when an abscess formed in the lumbar region and was opened. The patient was, however, so weak that a more serious operation was not advisable. The sinus was reopened three months ago, but the physical condition still contraindicated extensive exploration. The urine has contained a slight trace of pus from time to time, and some red blood-corpuscles. The skiagraph showed a large calculus in the left lumbar region opposite the intervertebral cartilage of the second and third lumbar vertebra. At the subsequent nephrolithotomy it was found that the shadow of the calculus had been cast by a mass of amorphous urates and phosphates contained in a crystalline shell that filled the pelvis of the kidney. This mass broke up readily under the finger, and contained minute uric acid calculi. The detection of a calculus of such character leaves no doubt of the accuracy and efficiency of this method, and its value in negative diagnoses.

CASE LIV.—November 14, 1899. Mr. C., referred by Dr. J. C. Da Costa. He had had yellow fever, followed by tropical malaria a year ago. His attack of acute pain in lumbar region began five weeks before the examination. The urinary analysis showed nothing except an increased amount just previous to an attack. The attacks have decreased in severity. Phosphatic crystals are seen in urine that has stood for some time. A series of negatives demonstrated the absence of all urinary calculi.

CASE LV.—November 16, 1899. Mr. H. B., referred by Dr. H. D. Jump. This patient had lumbar pain and symptoms that might have been due to calculus, but they were masked by a cystitis. The skiagraphic examination showed the absence of calculi.

CASE LVI.—November 18, 1899. F. M., referred by Dr. J. William White. The urinary analysis in this case showed pus in microscopic quantities, which increased later. Urine was acid. Specific gravity was 1075. There was no blood. The attacks were paroxysmal and intermittent in character, with no pain radiating into the testicle. The albumen was one-fourth by bulk. An enlarged kidney tumor could be recognized by percussion and in the skiagraph, but no calculus was present. A nephrotomy was performed on November 22. A hydronephrotic condition was found, but no calculi; numerous pockets of pus were opened. The negative diagnosis was confirmed.

CASE LVII.—November 25, 1899. F. W., referred by Dr. Alfred Stengel. The symptoms were atypical, and calculus was only suspected. The examination served to confirm the negative diagnosis.

CASE LVIII.—December 12, 1899. A. L. T., referred by Dr. A. J. Downes. The symptoms in this case were indefinite in character. The patient was stout and physical examination difficult. The skiagraphs showed the outline of the kidney, but no calculus was present.

CASE LIX.—December 12, 1899. Referred by Dr. D. D. Stewart. This patient had had attacks of pain following exertion, with a constant microscopic amount of blood and pus in the urine. The urine was acid and contained oxalate crystals. There was gastric disturbance in addition. This is the case mentioned above in which the plate failed to cover the left renal region, so that the shadow of the calculus was projected outside of it. It is the only case in which the negative diagnosis has been found in error. It was due to faulty technique and not to any defect in the method *per se.* A calculus (oxalate) was removed by Dr. W. W. Keen on January 6, 1899, twelve millimetres in length.